Notes on the ascus types in Crocicreas (Leotiales, Ascomycetes) with a characterization of selected taxa

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Abstract:
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Ten taxa of *Crocicreas* with a mainly European distribution, including the type species of *Crocicreas* and its suggested generic synonyms: *Belonioscypha, Conchatium* and *Cyathicula* are characterized using light microscopy. Three different amyloid ring structures of the asci occurring in this genus are described: the *Calycina*-type, the closely related *Conchatium*-type and the *Hymenoscyphus*-type. The non-amyloid ascus apical structure of a fourth group of taxa are regarded as having been derived from ascus tips with a ring of the *Hymenoscyphus*-type. With regard to the ascus types and some other more or less correlating characters two separate lineages within *Crocicreas* are recognized. The occurrence, shape and taxonomic value of strongly refractive vacuolar bodies in living paraphyses and cortical excipular hyphae is discussed. Notes on the generic delimitation of *Crocicreas* and *Allophylaria* are given. The new combination *Crocicreas fraxinophilum* (Svrcek) Triebel & Baral is proposed.

Zusammenfassung:
Zehn, vor allem in Europa verbreitete Sippen aus der Gattung *Crocicreas*, inklusive der Typusarten von *Crocicreas* und der hierin einzuschließenden, teils umstrittenen Genera *Belonioscypha, Conchatium* und *Cyathicula* werden lichtmikroskopisch charakterisiert. Drei verschiedene Typen amyloider Ringstrukturen in den Asci werden beschrieben: der *Calycina*-Typ, der eng verwandte *Conchatium*-Typ und der *Hymenoscyphus*-Typ. Die nicht amyloide Ascusapicalstruktur einer vierten Artengruppe wird als abgeleitet von einer Apicalstruktur mit Ring vom *Hymenoscyphus*-Typ interpretiert. Aufgrund der Ascusmerkmale und einiger damit mehr oder weniger korrelierender Merkmale lassen sich zwei Entwicklungslinien innerhalb *Crocicreas* unterscheiden. Das Auftreten, die Gestalt und die systematische Bedeutung stark lichtbrechender Vakuolarkörper in den lebenden Paraphysen und Rindenhyphen des Excipulums wird beschrieben und diskutiert. Probleme der Gattungsumgrenzung von *Crocicreas* und *Allophylaria* werden erörtert. Die Neukombination *Crocicreas fraxinophilum* (Svrcek) Triebel & Baral wird vorgeschlagen.

Introduction

The order Leotiales comprises mostly non-lichenized ascomycetes with apothecia characterized by an ascohymenial ontogeny and unitunicate, inoperculate asci which have an eversion type dehiscence. Although the size of the amyloid structure of the ascus apex is relatively small, e.g. five to ten times as narrow as those in the Lecanorales, leotialean asci are not difficult to study using simple light microscopical methods. Nevertheless, characters derived from the leotialean ascus apex have been generally neglected, not only in older but also in most modern systematic treatments.

Recent results gained from light microscopical and electron microscopical methods (BARAL 1987 a, TRIEBEL 1992, VERKLEY 1992, 1993 a, 1993 b, 1995) indicate that the asci in Leotiales provide a complex of taxonomically significant characters. Those observed using light microscopical methods include the shape of the ascus apex, relative thickness of its individual wall layers, the shape of the amyloid ring (annulus), its staining reactions in varying concentrations of Lugol's iodine solution and the type of dehiscence.

It is strongly recommended that fresh material is examined for a more complete and reliable characterization of leotialean taxa (BARAL 1992, HUHTINEN 1994). The presence and shape of strongly refractive vacuolar bodies, in particular, only visible in living cells of the paraphyses and of the cortical excipular hyphae, proved to be taxonomically relevant in certain groups, e. g., to distinguish between species of *Allophylaria* (P.Karst.) P.Karst. and *Crocicreas (Cyathicula)* (see discussion further below and BARAL 1992: 363 ff.).

The genus *Crocicreas* Fr. was described by FRIES (1849) for a single species, *Perisporium gramineum* Fr., which occurs on culms of grasses. The generic name was not accepted by most of the later authors. In 1864, DE NOTARIS described the genus *Cyathicula* De Not. to which he assigned eleven species. *Cyathicula coronata* (Bull.: Fr.) De Not., mostly growing on dead herbaceous stems, was chosen as the lectotype by CLEMENTS & SHEAR (1931) (see also CARPENTER & DUMONT 1978). *Cyathicula* was used by most of the earlier authors for leotialean taxa with stalked, gelatinous apothecia. REHM (1892), for instance, distinguished it by the dentate apothecial margin and the 0–1-septate ascospores from *Belonioscypha* Rehm (with 3-septate, mainly halonate ascospores) and *Phialea* (Fr.) Gillet (with edentate apothecial margin and 0–1-septate ascospores). VELENOVSKY (1934), DENNIS (1956) and SVRCEK (1979) generally maintained this generic concept. SVRCEK (1979) used the name *Conchatium* Velen. for most of the species placed in *Phialea* by DENNIS (1956).

CARPENTER (1981) provided a monographic treatment of this group of fungi. He regarded *Cyathicula* as well as *Belonioscypha* Rehm and with some hesitation also *Conchatium* Velen. (= *Phialea* sensu Rehm) as later synonyms of *Crocicreas*, as the hyphal tissues of their ascomata are very similar (CARPENTER 1981: 3, 4, 23). In the generic concept of CARPENTER (1981), *Crocicreas* comprises fungi of the family Leotiaceae with sessile to stalked, white, pale yellow, greyish or brown apothecia. The taxa have an ectal exciple consisting of long-celled, subparallel, occasionally branching and anastomosing hyphae immersed in a gelatinous matrix. The hyphoid cortical layer is often covered with large numbers of rhomboid crystals. Most species are found on dead herbaceous stems and culms, some on dead petioles, inflorescences or twigs of flowering plants.

Meanwhile the name *Phialea* (Pers.: Fr.) Gillet was rejected as illegitimate under ICBN Art. 56.1. and is not to be used (GREUTER et al.: 1994, Appendix IV).

CARPENTER's generic concept was followed by most authors. There are only a few doubts about the synonymization of *Crocicreas* and *Cyathicula* (see BARAL 1994, BARAL & KRIEGLSTEINER 1985, ERIKSSON & HAWKSWORTH 1987, 1993,

TRIEBEL & BARAL 1993). BARAL (in BARAL & KRIEGLSTEINER l.c.) restricted the name *Crocicreas* to *C. gramineum* (Fr.) Fr. var. *gramineum* and *C. gramineum* var. *incertellum* (Rehm) S.E.Carp., both taxa with lanceolate paraphyses. He treated fourteen species with cylindrical paraphyses under the name *Cyathicula*. The consistent absence of rhomboid crystals in *Crocicreas* was mentioned as a further distinguishing character between the two genera. Using light microscopical methods, TRIEBEL & BARAL (1993) studied the ascus apices of the type species of *Crocicreas* and *Cyathicula* emphasizing the differences in the amyloid ring structure. VERKLEY (1993 b) examined *Crocicreas cyathoideum* (Bull.: Fr.) S.E.Carp. var. *cyathoideum* and *Crocicreas pallidum* (Velen.) S.E.Carp., both species with cylindrical paraphyses, and found ultrastructural differences in features of their ascus apical apparatus. VERKLEY (1995: 186, 193) placed *C. pallidum* and *C. coronatum* in the "Hymenoscyphaceae" and *C. cyathoideum* close to the Sclerotiniaceae.

In the following, selected taxa of *Crocicreas* are characterized using light microscopical methods. These results, especially concerning the different ascus structures and some features which can only be observed in fresh material are presented as a contribution to a better understanding of the natural relationships within this group of fungi.

Material and methods

Herbarium material from K, LU, M, REG, UPS, and from some private herbaria (hb. CLERC, hb. SCHEUER and hb. BARAL) was studied. The majority of the species was also studied from fresh (living!) material which after examination was deposited in M or in hb. BARAL. Sections were made by hand or freezing microtome and mounted in tap water or various staining reagents i.e., iodine-potassium iodide solution (1%) [= Lugol's solution (MERCK 9261); I_{Lugol}], iodine-potassium iodide solution (3%) [$I_{Lugol\ conc}$], Melzer's reagent (original formula, without KOH-pretreatment) [I_{Melzer}] and aqueous Brilliant cresyl blue solution (1%). The specimens were examined by means of standard light microscopical techniques. Measurements of fresh material were made in tap water, those of dead herbarium material in water or in KOH (5–10%). The lipid content of living ascospores was studied in water, of dead spores in KOH. Further information on methods of measurements used here and the characterization of living material are given in BARAL (1992). The terms "euamyloid" and "hemiamyloid" are used in the sense of BARAL (1987 b).

Specimens examined:

Crocicreas calathicola: **France**. Dept. Savoie: Val-Thorens, 2500 m, on dead capitula of *Cirsium spinosissimum*, 26 August 1989, *Collin* (hb. BARAL 4047) – Haute Savoie, massif du Mt. Blanc, La Pierre à Beranger, 2440 m, on dead capitula of *Cirsium spinosissimum*, 1 August 1993, *Clerc* (hb. CLERC). – **Switzerland**. Kt. Tessin: Gotthardpass, surroundings of the mountain refuge "Cantoniera", near the shore of the river Reuss, on dead capitula of *Cirsium spinosissimum*, July 1882, *Winter* (RABENHORST & WINTER, Fungi europaei 2747 sub *Helotium calathicolum*; M). – **Austria**. Tirol: Ötztaler Alpen, Pitztal, surroundings of the mountain hut "Neue Chemnitzer Hütte" E of Plangeroß, on decaying capitula of *Cirsium spinosissimum*, 26 July 1961, *Poelt* (M) – Pitztal, Mittelberg, near the glacier "Taschach-Gletscher", c. 1920 m, on decaying capitula of *Cirsium spinosissimum*, August 1875, *Rehm* (REHM, Ascomyceten 305; M – isolectotype of *Helotium calathicola* Rehm). – Salzburg: Hohe Tauern, Durchgangswald, 1800 m, on old capitula of *Carlina acaulis*, 20 September 1990, *Rücker & Lohmeyer* (hb. BARAL 4243).

***Crocicreas coronatum*: Germany**. Brandenburg: Triglitz in der Prignitz, on decaying stems of *Solidago canadensis*, 10 October 1915, *Jaap* (JAAP, Fungi selecti exs. 762 sub *Cyathicula coronata*; M). – Baden-Württemberg: Tübingen-Pfrondorf, Tiefenbach, 410 m, on dead stems of cf. *Sanicula europaea*, 5 October 1985, *Baral* (hb. BARAL 2942) – Tübingen-Pfrondorf, Sophienpflege, 460 m, on dead stems of *Senecio erucifolius*, 30 August 1986, *Baral* (hb. BARAL 3067, M). – Sachsen: Surroundings of Königstein, on decaying stems of *Aster leucanthemus*, 4 October 1911, *Krieger* (KRIEGER, Fungi saxonici 2171 sub *Cyathicula coronata*; M).

***Crocicreas culmicola*: Germany**. Baden-Württemberg: Tübingen-Pfrondorf, Sophienpflege, 460 m, on dead culms of Poaceae, 13 June 1985, *Baral* (hb. BARAL 2929) – Tübingen, Schweigbrühl, 340 m, on dead culms of cf. *Poa* spec., 29 July 1988, *Marson & Baral* (hb. BARAL 3492). – Sachsen: Surroundings of Pulsnitz, on dry culms of *Molinia coerulea*, October 1881, *Staritz* (RABENHORST & WINTER, Fungi europaei 3165 sub *Belonidium vexatum*; M). – **U.S.A.** New York: Newfield, on old culms of *Andropogon*, November 1881, collector not indicated (ELLIS, North American Fungi 850 sub *Peziza vexata*; M).

***Crocicreas cyathoideum* var. *cyathoideum*: Germany**. Baden-Württemberg: Stuttgart-Feuerbach, Lemberg, close to Horn, 360 m, on dead stems of *Urtica dioica*, 10 May 1975, *Baral* (hb. BARAL 1063) – Tübingen-Pfrondorf, road Blaihofstraße, 430 m, on dead stems of cf. *Pimpinella major*, 31 May 1988, *Baral* (hb. BARAL 3426a) – Tübingen-Pfrondorf, Eichenfirst, 500 m, on dead stems of *Sambucus ebulus*, 8 July 1989, *Baral* (hb. BARAL 3791a). – Sachsen-Anhalt: Surroundings of Eisleben, "Wiesen", on decaying stems of *Epilobium hirsutum*, May 1879, *Kunze* (KUNZE, Fungi selecti exs. 294 sub *Peziza cacaliae* b. *epilobii*; M). – Bayern: Oberbayern, Landkreis Eichstätt, valley Affental c. 1.5 km NE of Buchenhüll, c. 430 m, on dead stems of *Urtica dioica*, 14 June 1990, *Triebel & Rambold* (TRIEBEL, Microfungi exs. 4 sub *Cyathicula cyathoidea*; M) – region "Bayrischer Wald", mountain Arber, on dead culms of grasses, September 1885, *Rehm* (REHM, Ascomyceten 863; M, growing intermixed with *Crocicreas megalosporum* var. *gramineum*). – **Austria**. Kärnten: Surroundings of Steindorf, near the lake "Ossiachersee", on stems of *Solanum tuberosum*, June, *v. Keissler* (Kryptogamae exs. 1170 sub *Phialea cyathoidea*; M).

***Crocicreas cyathoideum* var. *cacaliae*: Germany**. Schleswig-Holstein: Helgoland, Mittelland, Kringel, c. 10 m, on dead inflorescences of *Dipsacus silvestris*, 27 June 1986, *Lohmeyer* (hb. BARAL 4852, K). – **Switzerland**. Kt. Wallis: Verbier, on *Ononis repens*, 29 May 1955, *Müller* (M). – Kt. Graubünden: Davos, Davos-Dorf, Matten/Dischmatal, c. 1590 m, on dead culms and inflorescences of *Phleum* spec., 4 September 1990, *Baral & Weber* (hb. BARAL 4184). – **Austria**. Tirol: Surroundings of Sulden am Ortler, moraine of the glacier "Sulden Gletscher", on dead stems of *Trifolium pallescens*, c. 2700 m, July 1884, *Rehm* (REHM, Ascomyceten 810; M – isolectotype of *Helotium glanduliforme* var. *robustior* Rehm). – Niederösterreich: Surroundings of Rosenau, mountain Sonntagberg, on dry stems of *Ononis spinosa*, July, *Strasser* (Kryptogamae exs. 1321 sub *Phialea glanduliformis*; M).

***Crocicreas dolosellum*: Germany**. Niedersachsen: Ostfriesland, Norden, the village Berum, c. 0 m, on dead culms of cf. *Phalaris* spec., 17 November 1994, *Stabenau* (hb. BARAL 5188). – Bayern: Nature reserve "Nationalpark Bayrischer Wald", Spiegelau, Guglöd, Klosterforst, 785 m, on dead culms of grasses, 20 October 1989, *Luschka* (REG).

***Crocicreas fraxinophilum*: Germany**. Baden-Württemberg: Tübingen-Pfrondorf, Tiefenbach, 400 m, on petioles of *Fraxinus excelsior*, 21 October 1985, *Baral* (hb. BARAL 2947) – Same locality, 410 m, on dead petioles of *Fraxinus excelsior*, 24 October 1987, *Baral* (hb. BARAL 3293a). – Bayern: Oberbayern, Mittlere Isarau, T-crossing of the promenade on the E bank and the walking trail to the small village "Fischerhäuser", c. 3 km NNE of Ismaning, c. 475 m, on dead petioles of *Fraxinus excelsior*, 12 November 1995, *Triebel & Rambold* (will be distributed in TRIEBEL, Microfungi exs.; M, hb. BARAL).

***Crocicreas gramineum* var. *gramineum*: Sweden**. Lycksele Lappmark: Tärna par., southern slope of the mountain Ussmeten, about 1 km NW of the outlet of Lake Abelvattnet, on *Poa nemoralis*, 25 August 1968, *Lohammar* (UPS) – Sorsele s:n, "Bosse Grundströms hus" (RUBIN 25 G 8a 1612), on *Poa alpigena*, 29 July 1982, *Gustafsson* (UPS). – **Germany**.

Sachsen: Surroundings of Königstein, on dead leaves of grasses, May 1902, *Krieger* (KRIEGER, Fungi saxonici 1835 sub *Phialea stipae*; M). – **Austria**. Tirol: Surroundings of Sulden am Ortler, near the farm houses "Gampenhöfe", c. 2000 m, on dead leaves and stems of grasses, June 1884, *Rehm* (Rehm, Ascomyceten 767; M – isolectotype of *Helotium stigmaion* var. *minusculum* Rehm).

Crocicreas gramineum var. ***incertellum***: **Germany**. Thüringen: Surroundings of Erfurt, Steiger, on dead leaves of *Koeleria pyramidata*, June–July 1906, *Diedicke* (SYDOW, Mycotheca germanica 505 sub *Phialea incertella*; M).

Crocicreas megalosporum var. ***megalosporum***: **Austria**. Steiermark: Schladminger Tauern, Kleinsölk-Obertal, Schwarzensee, 1163 m, on leaves of *Carex rostrata*, 5 August 1984, *Scheuer* (hb. SCHEUER 675).

Crocicreas megalosporum var. ***gramineum***: **Germany**. Bayern: Region "Bayrischer Wald", mountain Arber, on dead culms of grasses, September 1885, *Rehm* (REHM, Ascomyceten 863; M – isolectotype of *Helotium dolosellum* (P.Karst.) Rehm f. *gramineum* Rehm; growing intermixed with *Crocicreas cyathoideum* var. *cyathoideum*).

Crocicreas starbaeckii: **France**. Dept. Vosge: Gérardmer, near Les Vasenes, Le Cerceneux Marion, c. 950 m, on dead stems of *Ranunculus aconitifolius*, 4 June 1988, *Deny* (hb. BARAL 3434). – **Germany**. Brandenburg: Potsdam, bog Fresdorfer Moor, on dead stems of *Equisetum fluviatile*, 30 June 1970, *Benkert* (K). – Hessen: Prov. Hessen-Nassau, Rhöngebirge, surroundings of Gersfeld, mountain Eube, on decaying stems of *Ranunculus* spec., 6 July 1907, *Sydow* (SYDOW, Mycotheca germanica 599 – isolectotype of *Phialea turbinata* Sydow; M). – **Switzerland**. Kt. Luzern: Luzern. Stans, S of Wirzweli, Engelberger Au, close to Horn, c. 1200 m, on dead stems of *Ranunculus mollis*, 9 June 1985, *Baral & Breitenach* (hb. BARAL 2922a). – **U.S.A**. New York: Essex Co., North Elba Township, Trailhead, Northville-Placid Trail, Averyville, along Chubb River, on dead stems of *Ranunculus* spec., 8 June 1991, *Haines 4658, Raitviir & Spooner* (K).

Results

The ascus types and some other diagnostically relevant features in *Crocicreas*

Living asci of *Crocicreas* have very thin apical thickenings (see fig. 6a, 7a, 8a, 10a,b and 12a), which expand as a result of the "imbibition effect" in the dead state (see BARAL 1992: 351).

Valuable taxonomic characters can be derived from dead asci after treatment with Lugol's solution. The ascus apices of four groups of species are described below. One group has non-amyloid ascus apices. The others have ascus apices with amyloid ring structures of three different types: the *Calycina*-type, the *Conchatium*-type and the *Hymenoscyphus*-type.

1. The ascus apex of *Crocicreas* s. str. with ring of the *Calycina*-type (*Crocicreas gramineum* var. *gramineum*, *C. gramineum* var. *incertellum*; figs. 1–3)

The ascus apex is subconical. The apical thickening (for definition see BELLEMÈRE 1994: 116; VERKLEY 1992: 5; fig. 13 in this paper) is rather reduced. The amyloid annulus (= ring), especially its apical part which spreads in lateral direction, is rather thick in comparison to the thickness of the central cylinder (for definitions see BELLEMÈRE 1994: 116; VERKLEY 1992: 5; fig. 13 in this paper). The basal end of the ring strongly protrudes into the ascoplasm (annular protrusion, "pendatif"; for definition see BELLEMÈRE 1994: 116; VERKLEY 1992: 5; fig. 13 in this paper). The iodine reaction is strong in all parts; using Lugol's solution (without KOH-pretreatment) the amyloid ring shows a strongly blue reaction. Only at the basal end is a tendency to a dirty grey-red reaction observable. At higher concentrations the whole

ring stains distinctly reddish. In Melzer's reagent the ring turns blue (without KOH-pretreatment). After complete eversion during discharge, the ring retracts to c. 45°. No collarette-like structure is seen in dehisced asci ("foramen immarginé" sensu BOUDIER 1885: 92).

The obconical (somewhat T-like) shape of the ring resembles that of the species of *Mollisia* (Fr.) P.Karst., *Incrucipulum* Baral and *Calycina* Nees ex Gray figured by BARAL (1987 a: figs. 24–26). This type of amyloid ring was included within the *Bulgaria*-type by BARAL (l.c.) but is here separated as *Calycina*-type, because it is distinctly thinner than the ring in *Bulgaria* Fr. Furthermore the asci with an amyloid ring of the *Calycina*-type have distinctly thinner ascus walls than those in *Bulgaria*. The *Calycina*-type is close to the *Laetinaevia*-type (BARAL l.c.: figs. 18–22) but the apical part of the ring does not so strongly spread in lateral direction. The *Calycina*-type of amyloid ring also resembles the *Conchatium*-type (see below). The iodine reaction is classified as hemiamyloid, type RB (fide BARAL 1987 b). VERKLEY's "type VIII (preliminary): '*Chlorociboria-Pezizella-Calycina*'" (VERKLEY 1995: 186) based on the ultrastructure of the ascus apical apparatus mainly coincides with the *Calycina*-type circumscribed here but also includes the ring type of *Crocicreas cyathoideum* (here referred to as *Conchatium*-type).

2. The ascus apex of the *Crocicreas cyathoideum*-group with ring of the *Conchatium*-type (*C. cyathoideum* var. *cyathoideum*, *C. cyathoideum* var. *cacaliae*, *C. dolosellum*, *C. fraxinophilum*, *C. starbaeckii*; figs. 4–7)

The ascus apex is rounded to conical but never papillate. The apical thickening is more or less reduced; the amyloid ring is rather thick compared with the thickness of the central cylinder. The apical part of the ring is parallel or slightly spreads in lateral direction, its basal end shows a more or less distinct annular protrusion; the iodine reaction is strongly blue in all parts of the ring, or fades somewhat in its upper half; it is bluish at concentrations up to 3% iodine (BB, euamyloid). After discharge the everted ring retracts at least to c. 45°, thereby resembling undischarged asci of the *Calycina*-type. No collarette-like structure is observable ("foramen immarginé").

For this type of amyloid ring the term *Conchatium*-type is introduced here. It is intermediate between the *Calycina*- and *Hymenoscyphus*-type and sometimes not easily distinguishable from the former (see above, and fig. 3, 6).

3. The ascus apex of the *Crocicreas coronatum*-group with ring of the *Hymenoscyphus*-type (*C. calathicola, C. coronatum, C. culmicola*; figs. 8–12)

The ascus apex is conical and more or less papillate. The apical thickening is abundant. The amyloid ring is quite thin in all parts compared to the thickness of the central cylinder. The apical part of the ring is parallel or scarcely spreads laterally, and its basal end scarcely protrudes into the ascoplasm. The iodine reaction is weak to strong in the basal part, and fades or disappears abruptly towards the apex; it is bluish at concentrations up to 3% iodine (BB, euamyloid). After discharge, the everted ring retracts to c. 45°, the apical thickening is still present. In most cases a distinct collarette-like structure is observed ("foramen marginé" sensu BOUDIER 1885: 92).

The parallel-cylindrical shape of the apically fading ring closely resembles that of *Hymenoscyphus* Gray (after exclusion of misplaced taxa). It was already referred to as *Hymenoscyphus*-type by BARAL (1987 a: 126, figs. 10–12). The electron micrographs of *Crocicreas pallidum* (VERKLEY 1993 b: fig. 16, 17, 66) are quite similar at the ultrastructural level and were categorized by VERKLEY (1995: 187) as "Type XIII: *Hymenoscyphus*".

4. The ascus apex of the *Crocicreas megalosporum*-group without an amyloid ring (*C. megalosporum* var. *megalosporum*, *C. megalosporum* var. *gramineum*)

This type of ascus apex is not treated in detail here because it completely lacks an iodine reaction in Lugol's solution or Melzer's reagent (with or without KOH-pretreatment). The apical thickening is abundant, and a weak "foramen marginé" is present in discharged asci. The shape of the ascus apex, the development of a "foramen marginé" and the large guttulate ascospores resemble those of the *C. coronatum*-group.

The amyloid ring structures recognizable under light microscopy are important taxonomic characters. These structures "largely correspond with the structurally differentiated part observed in TEM, which usually reacts strongly in the PA-TCH-SP procedure" (VERKLEY 1995: 162). However, PA-TCH-SP-reactive structures do not always react with iodine (VERKLEY l.c.).

Some other diagnostically relevant features in *Crocicreas* are given in tab.1. One of these concerns the presence or absence of croziers. This character proved to be useful on species or variety level except in *Crocicreas cyathoideum* var. *cyathoideum* and *C. cyathoideum* var. *cacaliae*. There it is constant within the same population but varies within the same taxon.

In all species of *Crocicreas* studied from fresh collections, the living paraphyses and some cortical hyphae of the ectal exciple contain many small, roundish, strongly refractive, hyaline vacuolar bodies (see BARAL 1992: 365, fig. 27 for *C. fraxinophilum*) which take up basic dyes like cresyl blue. These bodies become reddish-brown by oxidation if pressed or otherwise damaged. This is one of the reasons for the darker colour of the (dead) apothecia in herbarium material, even if rehydrated, than in fresh material. These guttules completely disappear in herbarium specimens. Since up to now there have been no fresh collections of *Crocicreas gramineum* var. *gramineum* or *C. gramineum* var. *incertellum* available to us, and no information on the vacuolar bodies to be found in the literature, we know nothing about their presence in the *Crocicreas gramineum*-group (see also discussion further below).

A characterization of selected taxa

In the following, ten taxa of *Crocicreas* with a mainly European distribution, including the type species of *Crocicreas* and its suggested generic synonyms: *Belonioscypha*, *Conchatium* and *Cyathicula* are characterized. Regarding the features discussed above, we feel unable to accept *Cyathicula* as a separate genus as proposed by BARAL (in BARAL & KRIEGLSTEINER 1985). Therefore the concept of CARPENTER (1981), who used the older name *Crocicreas* in a wide sense, is accepted here.

1. *Crocicreas calathicola* (Rehm) S.E.Carp.

Characters derived from herbarium specimens. Apothecial morphology: Apothecia pale brown, stipitate; margin non dentate or with small teeth up to 50 µm long. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium absent or few present. Paraphyses 1.5–3 µm wide, cylindrical, exceeding the asci by 0–6 µm. Asci 45–68 µm long, 5–6 µm wide, not-stalked or short-stalked, with croziers. Ascus apex (fig. 8–9) hemispherical to subconical; apical thickening well developed, 0.5–2 µm tall; amyloid ring of *Hymenoscyphus*-type, 0.8–1.2 µm wide, 0.9–2 µm tall (immature state), 0.8–1.2 µm wide, 0.5–0.8 µm tall (mature state), at the top not or rarely very slightly spreading, I_{Lugol} + pale blue to blue (euamyloid), rarely negative,

I $_{Melzer}$ + pale blue or negative, slightly protruding into the ascoplasm; with a more or less distinct "foramen marginé" after spore discharge. Ascospores 0-septate, 6–10.5 µm long, 2.5–3.5 µm wide; lipid content very low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia pale yellowish. Apothecial anatomy: Paraphyses (3–)4–5 µm wide. Asci 70–92 µm long, 6.5–7.4 µm wide. Ascospores 7–11 µm long, 3–4 µm wide. Vacuolar bodies (in cells of paraphyses and cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

Notes. The shape of the ascus apex is hemispherical to subconical (fig. 8–9) and shows some similarities to that of *Crocicreas fraxinophilum* (fig. 7), a species with amyloid ring of the *Conchatium*-type.

2. *Crocicreas coronatum* (Bull.: Fr.) S.E.Carp., the type species of *Cyathicula* DeNot.

Characters derived from herbarium specimens. Apothecial morphology: Apothecia reddish-ochraceous to pale brown, short- to long-stipitate; margin distinctly dentate; teeth acute, 200–500 µm long. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium present or rarely absent. Paraphyses 2–2.5 µm wide, cylindrical, exceeding the asci by c. 5–10 µm or not. Asci 75–105 µm long, 6–10 µm wide, with a long tapering stalk, with croziers. Ascus apex (fig. 10–11) papillate to conical; apical thickening well-developed, 2.4–3.3 µm tall (immature state), 1–1.5 µm tall (mature state); amyloid ring of *Hymenoscyphus*-type, 0.7–1.5 µm wide, 1–3 µm tall, not spreading at the top, I $_{Lugol}$ + blue (euamyloid), I $_{Melzer}$ + blue, at the base scarcely protruding into the ascoplasm; with "foramen marginé" after spore discharge. Ascospores 0(–1)-septate, 12–19 µm long, 3–4(–5.5) µm wide; lipid content very high.

Additional characters derived from fresh material. Apothecial morphology: Apothecia cream-white. Apothecial anatomy: Paraphyses 3–3.5 µm wide, 7–10 µm shorter than mature asci. Asci 100–140 µm long, 9–11.8 µm wide. Ascus apex apical thickening 0.6–1.2 µm tall. Ascospores (13–)15–22(–24) µm long, (3–)3.5–5(5.3) µm wide. Vacuolar bodies (in cells of paraphyses and cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

Notes. This species is treated in detail by BELLEMÈRE (1958, 1967: 872–876). His figures (BELLEMÈRE 1958: fig. 3, 1967: fig. 139) show the refractive granulation in cells of the paraphyses and cortical hyphae, and the typical shape of the amyloid ring structure in the ascus apex.

3. *Crocicreas culmicola* (Desm.) S.E.Carp., the type species of *Belonioscypha* Rehm

Characters derived from herbarium specimens. Apothecial morphology: Apothecia pale brown to dark brown, substipitate to long-stipitate; margin non dentate or with distinct broad triangular teeth c. 80–120 µm long. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium present or rarely absent. Paraphyses 2–4.5 µm wide, cylindrical, apically obtuse, sometimes apically moniliform, exceeding the asci by c. 5–20 µm or not. Asci 110–153 µm long, 10.5–15 µm wide, not-stalked or more or less shortly attenuated towards the base, with croziers. Ascus apex (fig. 12) papillate to conico-papillate; apical thickening well developed, 2–3 µm tall (immature state), 1–1.5 µm tall (mature state); amyloid ring of *Hymenoscyphus*-type, 1.4–3.5 µm wide, 1–3 µm tall (immature state), slightly spreading at the top, I $_{Lugol}$ + strongly blue (euamyloid), I $_{Melzer}$ + blue, at the base slightly protruding into the ascoplasm; with

"foramen marginé" after spore discharge. Ascospores 3-septate, distinctly halonate, 18–25 µm long, 3.5–6 µm wide; lipid content low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia white to rose. Apothecial anatomy: Paraphyses 3.5–5 µm wide, 15–20 µm shorter than mature asci. Asci (128–)135–193(–234) µm long, 13–15(–16.5) µm wide. Ascus apex apical thickening c. 0.7–1 µm tall. Ascospores (23–)25–31(–35) µm long, (3.5–)3.8–4.5(–4.7) µm wide. Vacuolar bodies (in cells of paraphyses and cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

4. *Crocicreas cyathoideum* (Bull.: Fr.) S.E.Carp. var. *cyathoideum*

Characters derived from herbarium specimens. Apothecial morphology: Apothecia pale brown, stipitate; margin non dentate or with teeth 20–30 µm long. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium present or rarely absent. Paraphyses 1.5–3.6 µm wide, cylindrical, exceeding the asci by c. 5–7 µm or not. Asci 35–62 µm long, 4.4–6 µm wide, short-stalked, with croziers or sometimes with simple septa. Ascus apex (fig. 5) slightly conical; apical thickening scarcely developed, 0.8–1.1(–1.5) µm tall; amyloid ring of *Conchatium*-type, 0.7–0.8(–1.2) µm wide, 0.7–0.9 µm tall (immature state), 0.6–0.8 µm tall (mature state), I_{Lugol} + strongly blue (euamyloid), I_{Melzer} + blue, somewhat protruding into the ascoplasm when immature, strongly protruding when mature; with "foramen immarginé" after spore discharge. Ascospores 0-septate, 7–12.3 µm long, 1.5–2.5 µm wide; lipid content low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia white to ochraceous. Apothecial anatomy: Paraphyses 2.5–3.8 µm wide, 3–5 µm shorter than mature asci. Asci 52–65(–75) µm long, 4.5–6.3 µm wide. Ascospores (6–)7–11(–13) µm long, 1.7–2.3(–2.5)µm wide. Vacuolar bodies (in cells of paraphyses and cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

5. *Crocicreas cyathoideum* var. *cacaliae* (Pers.: Fr.) S.E.Carp., the type species of *Conchatium* Velen.

Characters derived from herbarium specimens. Apothecial morphology: Apothecia pale brown to dark brown, short-stipitate to stipitate; margin non dentate or subdentate. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium absent or abundant. Paraphyses 1.5–2 µm wide, cylindrical, exceeding the asci by c. 5–10 µm or not. Asci 42–53 µm long, 5–6 µm wide, not-stalked, with croziers or with simple septa. Ascus apex slightly conical; apical thickening scarcely developed, 1.5–2 µm tall; amyloid ring of *Conchatium*-type, 1–1.5 µm wide, 1.2–2 µm tall, slightly spreading at the top, I_{Lugol} + blue (euamyloid), I_{Melzer} + blue, scarcely protruding into the ascoplasm; with "foramen immarginé" after spore discharge. Ascospores 0-septate, (7.5–)10–14 µm long, 2–2.5(–3) µm wide; lipid content low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia cream-olivaceous. Apothecial anatomy: Asci 55–60 µm long, 5.8 µm wide. Ascospores 8–13.4 µm long, 1.8–2.8 µm wide. Vacuolar bodies (in cells of paraphyses and cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

Notes. This taxon is closely related to *C. cyathoideum* var. *cyathoideum* and is treated here in accordance with CARPENTER (1981) at varietal rank.

6. *Crocicreas dolosellum* (P.Karst.) S.E.Carp.

Characters derived from herbarium specimens. Apothecial morphology: Apothecia greyish-ochraceous to red-brown, stipitate; margin with narrow, acute teeth 50–100 µm long. Apothecial anatomy: Rhomboid crystals on the outer surface of the marginal teeth abundant. Paraphyses 2.5–3.3 µm wide, apically cylindrical or slightly attenuated, with rounded apices, exceeding the asci by c. 0–8 µm. Asci 52–59 µm long, 5–5.5(–6) µm wide, slightly attenuated towards the base, with simple septa. Ascus apex (fig. 6) slightly conical; apical thickening slightly developed, 0.7–1.2 µm tall; amyloid ring of *Conchatium*-type, 0.8–0.9 (–1) µm wide, 0.7–1.2 µm tall (immature and mature state), scarcely or rarely distinctly spreading at the top, I_{Lugol} + blue (euamyloid), I_{Melzer} + blue, somewhat protruding into the ascoplasm, apically scarcely fading; with an indistinct "foramen marginé" after spore discharge. Ascospores 1-septate, 13–16 (–17.5) µm long, 2.3–2.6 µm wide; lipid content relatively low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia whitish-cream. Apothecial anatomy: Paraphyses 3.3–4.2 µm wide. Asci 62–73(–78) µm long, 6.3–6.7(–7) µm wide. Ascospores (11–)13–18(–19.5) µm long, 2.3–2.7(–2.9) µm wide. Vacuolar bodies (in apical cells of paraphyses and in cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

Notes. This species is characterized by the ascospores which are already 1-septate in mature living asci. *Crocicreas culmicola* differs in the 3-septate halonate ascospores and by the ascus apex with an amyloid ring of *Hymenoscyphus*-type. The specimen figured by BREITENBACH & KRÄNZLIN (1981: fig. 193) as *Cyathicula dolosella* was re-examined by one of the authors (H.O.Baral) and found to represent *Crocicreas pallidum* or a taxon closely related to it.

7. *Crocicreas fraxinophilum* (Svrcek) Triebel & Baral comb. nov.
Basionym: *Conchatium fraxinophilum* Svrcek, Ceská Mykol. 40: 205 (1986).

Characters derived from herbarium specimens. Apothecial morphology: Apothecia ochraceous, long-stipitate; margin with broad teeth 50–80 µm long. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium present or rarely absent. Paraphyses 2–2.7 µm wide, apically cylindrical to slightly lanceolate, with broadly rounded apices, exceeding the asci by c. 2–9 µm. Asci 60–76 µm long, 5.3–5.7 µm wide, with a long attenuated base, with croziers. Ascus apex (fig. 7) slightly to distinctly conical; apical thickening weakly developed, 1.6 µm tall (immature state), 1 µm tall (mature state); amyloid ring of *Conchatium*-type, 0.7 µm wide, 1–1.6 µm tall, not spreading at the top, I_{Lugol} + strongly blue (euamyloid), I_{Melzer} + blue, protruding into the ascoplasm; with a more or less distinct "foramen immarginé" after spore discharge. Ascospores 0-septate, 11.5–14.5 µm long, 2–2.2 µm wide; lipid content low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia whitish. Apothecial anatomy: Paraphyses 2.7–3.7 µm wide, c. 4 µm shorter than mature asci. Asci (75–)80–90(–100) µm long, 7–8(–8.5) µm wide. Ascus apex apical thickening 0.3–0.4 µm tall. Ascospores (13–)14–18(–20) µm long, (2.2–)2.5–2.8(–3) µm wide. Vacuolar bodies (in cells of paraphyses and cortical hyphae of ectal exciple) abundant, small, roundish, strongly refractive.

Notes. For further information on this species see BARAL (1993: 5).

8. *Crocicreas gramineum* (Fr.) Fr. var. *gramineum*, the type species of *Crocicreas*

Characters derived from herbarium specimens. Apothecial morphology: Apothecia dark brown, substipitate; margin non dentate or with very small teeth. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium absent. Paraphyses 1.5–5 µm wide, some lanceolate, exceeding the asci by c. 8–22 µm, some cylindrical. Asci 35–54 µm long, 5–8.5 µm wide, not-stalked, with croziers. Ascus apex (fig. 1–2) subconical; apical thickening weakly developed, 1–1.5 µm tall; amyloid ring of *Calycina*-type, 1.2–1.6 µm wide, 1–1.5 µm tall, spreading at the top, I_{Lugol} + dirty brown to blue, basally dirty brown to red-brown, $I_{Lugol\ conc}$ + red-brown (hemiamyloid, type RB), I_{Melzer} + blue, strongly protruding into the ascoplasm; with "foramen immarginé" after spore discharge. Ascospores 0-septate, 8–12.5 µm long, 2–3 µm wide; lipid content relatively high.

Notes. Fresh material has not been available. The iodine reaction is classified as hemiamyloid. The red (hemiamyloid) reaction may change to blue (euamyloid) in older herbarium material as was demonstrated for a number of specimens of *Pezicula* Tul. & C.Tul. more than c. 40 years old (BARAL 1992: 374). However, in one specimen of *Crocicreas gramineum* collected in 1884 (REHM, Ascomyceten 767, M), the reaction was still somewhat reddish but only at a high iodine concentration.

Crocicreas gramineum has two types of paraphyses: lanceolate paraphyses which exceed the asci and cylindrical ones (CARPENTER 1981). In KOH some variation in the occurrence of lanceolate paraphyses and the ascospore measurements is observable: One specimen (*Gustafsson*; UPS) has many lanceolate paraphyses of very variable thickness (c. 2–5 µm) which overtop the asci by c. 8–22 µm. The spores measure 8–9.2 × 2–2.2 µm. Another specimen (REHM, Ascomyceten 767; M) has only a few lanceolate paraphyses (1.8–2.2 µm wide) which scarcely exceed the asci and spores of 11–12.5 × 2.5–3 µm. A third specimen (KRIEGER, Fungi saxonici 1835; M) has also only a few lanceolate paraphyses (1.5–3.2 µm wide) which exceed the asci by c. 10–13 µm and spores of 8.5–10 × 2–2.5 µm.

9. *Crocicreas gramineum* var. *incertellum* (Rehm) S.E.Carp.

Characters derived from herbarium specimens. Apothecial morphology: Apothecia dark brown, substipitate; margin non dentate or with very small teeth. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium absent. Paraphyses 1–4 µm wide, some cylindrical, some lanceolate, the latter exceeding the asci by c. 9–20 µm. Asci 24–35 µm long, 4.5–5.5 µm wide, not-stalked, with croziers. Ascus apex (fig. 3) subconical; apical thickening weakly developed, 1 µm tall; amyloid ring of *Calycina*-type, 0.8–1.2 µm wide, 0.8–1.2 µm tall, slightly spreading at the top, I_{Lugol} + and $I_{Lugol\ conc}$ + blue, scarcely turning dirty brown (euamyloid), I_{Melzer} + blue, strongly protruding into the ascoplasm; with "foramen immarginé" after spore discharge. Ascospores 0-septate, 6–7.5 µm long, 1.5–2 µm wide; lipid content fairly high.

Notes. Fresh material has not been available. *Crocicreas gramineum* var. *incertellum* is distinguished from the type variety of *C. gramineum* by the shorter asci and ascospores, and the pale brown hyphae of the medullary exciple (see also CARPENTER 1981: 121). This pigmentation has some similarities with that of *Crocicreas starbaeckii* (see below).

10. *Crocicreas starbaeckii* (Rehm) S.E.Carp.

Characters derived from herbarium specimens. Apothecial morphology: Apothecia pale brown, urceolate, stipitate; margin non dentate. Apothecial anatomy: Rhomboid crystals on the outer surface of the apothecium abundant, rarely absent. Paraphyses 2–3(–4) µm wide, cylindrical or often sublanceolate, sometimes subapically swollen, with obtuse apices, exceeding the asci by c. 3–10 µm. Asci 42–52 µm long, 4–5.5 µm wide, short-stalked, with croziers. Ascus apex (fig. 4) slightly conical; apical thickening weakly developed, 0.5–1 µm tall; amyloid ring of *Conchatium*-type, 0.7–1 µm wide, 0.7–1.2 µm tall (immature state), 0.5–0.7 µm tall (mature state), not or slightly spreading at the top, I_{Lugol} + blue (euamyloid), I_{Melzer} + blue, strongly protruding into the ascoplasm; with "foramen immarginé" after spore discharge. Ascospores 0-septate, 7.5–10 µm long, 1.4–2 µm wide; lipid content fairly low.

Additional characters derived from fresh material. Apothecial morphology: Apothecia greyish-white. Apothecial anatomy: Paraphyses 2–4(–5) µm wide. Asci 47–67 µm long, 4.7–5.4(–6.5) µm wide. Ascospores 6–11 µm long, 1.6–2.4 µm wide. Vacuolar bodies (in apical cells of paraphyses and in cortical hyphae of ectal exciple) more or less abundant, small, roundish, strongly refractive.

Notes. The hyphae of the medullary exciple are dark olivaceous brown and granulate and resemble those of *Crocicreas gramineum* var. *incertellum*. The paraphyses of *C. starbaeckii* are often sublanceolate and may represent a transition to the lanceolate paraphyses of *C. gramineum*.

Discussion and conclusions

According to CARPENTER (1981: 23) the genus *Crocicreas* is mainly characterized by the ectal exciple consisting of long-celled, subparallel, occasionally branched and anastomosed hyphae immersed in a gelatinous matrix (textura oblita).

Within the genus *Crocicreas* three different types of amyloid ascus apical apparatus have been found: the *Calycina*-type in the type species of the genus (*Crocicreas gramineum*), the *Conchatium*-type in the *C. cyathoideum*-group (*C. cyathoideum*, *C. dolosellum*, *C. fraxinophilum*, *C. starbaeckii*), and the *Hymenoscyphus*-type in the *C. coronatum*-group (i.e. *C. calathicola, C. coronatum, C. culmicola*). A non-amyloid ascus apical apparatus occurs in *C. megalosporum* (Rea) S.E. Carp. var *megalosporum* and in *C. megalosporum* var. *gramineum* (Rehm) S.E.Carp. (see also CARPENTER 1981).

Crocicreas in its narrow sense has asci with obconical apical rings of the *Calycina*-type. The *Conchatium*-type of the *C. cyathoideum*-group shows certain similaries to this type but lacks the apical spreading and the hemiamyloid reaction of the basal part. The *Hymenoscyphus*-type of the *C. coronatum*-group is clearly distinguishable from both types. It has a parallel-cylindrical, apically fading amyloid ring. The ascus apex is more or less papillate and strongly thickened. It has the same very characteristic shape as the ascus apex in the non-amyloid asci of *C. megalosporum*. Therefore it is suggested that the latter has evolved as a reduction of the amyloid ring of the *Hymenoscyphus*-type. Further leotialean genera which comprise taxa with amyloid asci beside others with inamyloid asci are *Lachnellula* P.Karst., *Mollisia* (Fr.) P.Karst., *Pyrenopeziza* Fuckel and *Vibrissea* Fr. (BARAL 1987 b: 438, tab. 6; NANNFELDT 1976: 284, 285).

The variation in the ascus apical apparatus of *Crocicreas* might support a subdivision of the genus into two separate lineages: *C. gramineum* and the *C. cyathoi-*

deum-group as the first lineage, and the *C. coronatum*-group and *C. megalosporum*-group as the second lineage. The differences observed in the ascus apex are correlated with the spore width and to a certain extent with the shape of the paraphyses and the colour of the apothecia (see tab. 1). The first group of species has narrow ascospores (1.5–3.5 µm) while the second group has broad ascospores (3.0–6 µm). These two lineages do not correlate with the occurrence of teeth at the apothecial margins or the spore septation (see tab. 1): features which formerly were used for the generic delimitation of *Cyathicula* and *Phialea/Conchatium* (e.g. REHM 1892, SVRCEK 1979).

The genus *Allophylaria* (P.Karst.) P.Karst. (type species: *A. sublicoides* (P.Karst.) P.Karst.) is very similar to *Crocicreas*, for instance in the ectal exciple consisting of relatively long-celled, parallel hyphae immersed in a gelatinous matrix (textura oblita). According to CARPENTER (1981: 18) it should be distinguished from the latter by the strongly parallel, non-ramifying hyphae of the ectal exciple seen in surface view. Species of *Allophylaria* lack rhomboid crystals and are often substipitate. Their asci have an obconical shaped amyloid ring with a pronounced lateral spreading, i.e. of the *Laetinaevia*-type. The ring shows a red-brown (hemiamyloid) iodine reaction (BARAL 1987 b: 126–127, fig. 21, 22). This type of amyloid ring may represent a transition to the *Calycina*-type of *Crocicreas gramineum* and indicates a close relationship between the two genera.

A very useful tool to distinguish *Allophylaria* from *Crocicreas* is found in studying the refractive vacuolar bodies of living cells of paraphyses and cortical hyphae of the ectal exciple: The vacuolar bodies of *Allophylaria* (including the type species) are always large and elongate (BARAL & KRIEGLSTEINER 1985: 94; BARAL 1992: 365, fig. 28: *A. nervicola* (Velen.) Baral) while those of *Crocicreas* are smaller, roundish and occur in a much higher number in the cells (BARAL 1992: 365, fig. 27: *C. fraxinophilum*). Unfortunately there are no data available about the vacuolar bodies in *C. gramineum*, the type species of *Crocicreas*, and therefore the generic circumscription of *Allophylaria* and *Crocicreas* still remains somewhat uncertain.

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Tab. 1: Diagnostically relevant features in *Crocicreas*.

Characters	*C. gramineum*	*C. cyathoideum*-group	*C. coronatum*-group	*C. megalosporum*-group
Apothecial stalk	-/+	+/++/+++	++/+++	++
Apothecium colour (herbarium material)	dark brown	pale brown to dark brown	pale (yellow)-brown	pale brown
Teeth at the apothecial margin	-	-/+	-/+	-
Rhomboid crystals	-	-/+	-/+	-
Shape of the paraphyses	lanceolate, cylindrical	cylindrical, sublanceolate	cylindrical	cylindrical
Vacuolar bodies	?	+	+	+
Type of the amyloid ring at the ascus apex	*Calycina*	*Conchatium*	*Hymenoscyphus*	no amyloid ring
Foramen marginé and papillate ascus apex	-/(+)	-/(+)	+/(-)	+/(-)
Croziers at the ascus base	+	-/+	+	-
Ascospore septation	-	-/+	-/+	-
Ascospore width [µm] (dead state)	1.5–3.5	1.5–3.0	3.0–5.5	3.0–6.0

Fig. 1–7. The ascus apices of *Crocicreas gramineum* and of selected taxa of the *C. cyathoideum*-group (drawn from dead asci, mounted in I $_{\text{Lugol conc}}$, if not otherwise indicated).
1. *Crocicreas gramineum* var. *gramineum* (*Gustafsson*; UPS): immature (a), mature (b). – 2. *Crocicreas gramineum* var. *gramineum* (REHM, Ascomyceten 767; M): immature (a), dehisced (b). – 3. *Crocicreas gramineum* var. *incertellum* (SYDOW, Mycotheca germanica 505; M): immature (a), mature (b). – 4. *Crocicreas starbaeckii* (*Deny*; hb. BARAL 3434): immature (a), mature (b), dehisced (c–d). – 5. *Crocicreas cyathoideum* var. *cyathoideum* (TRIEBEL, Microfungi exs. 4; M): immature (a), mature (b), dehisced (c). – 6. *Crocicreas dolosellum* (*Stabenau*; hb. BARAL 5188): mature, drawn from living asci, mounted in water (a), mature (b–c), dehisced (d). – 7. *Crocicreas fraxinophilum* (*Baral*; hb. BARAL 2947): mature, drawn from living asci, mounted in water (a), immature (b), mature (c), dehisced (d–e).

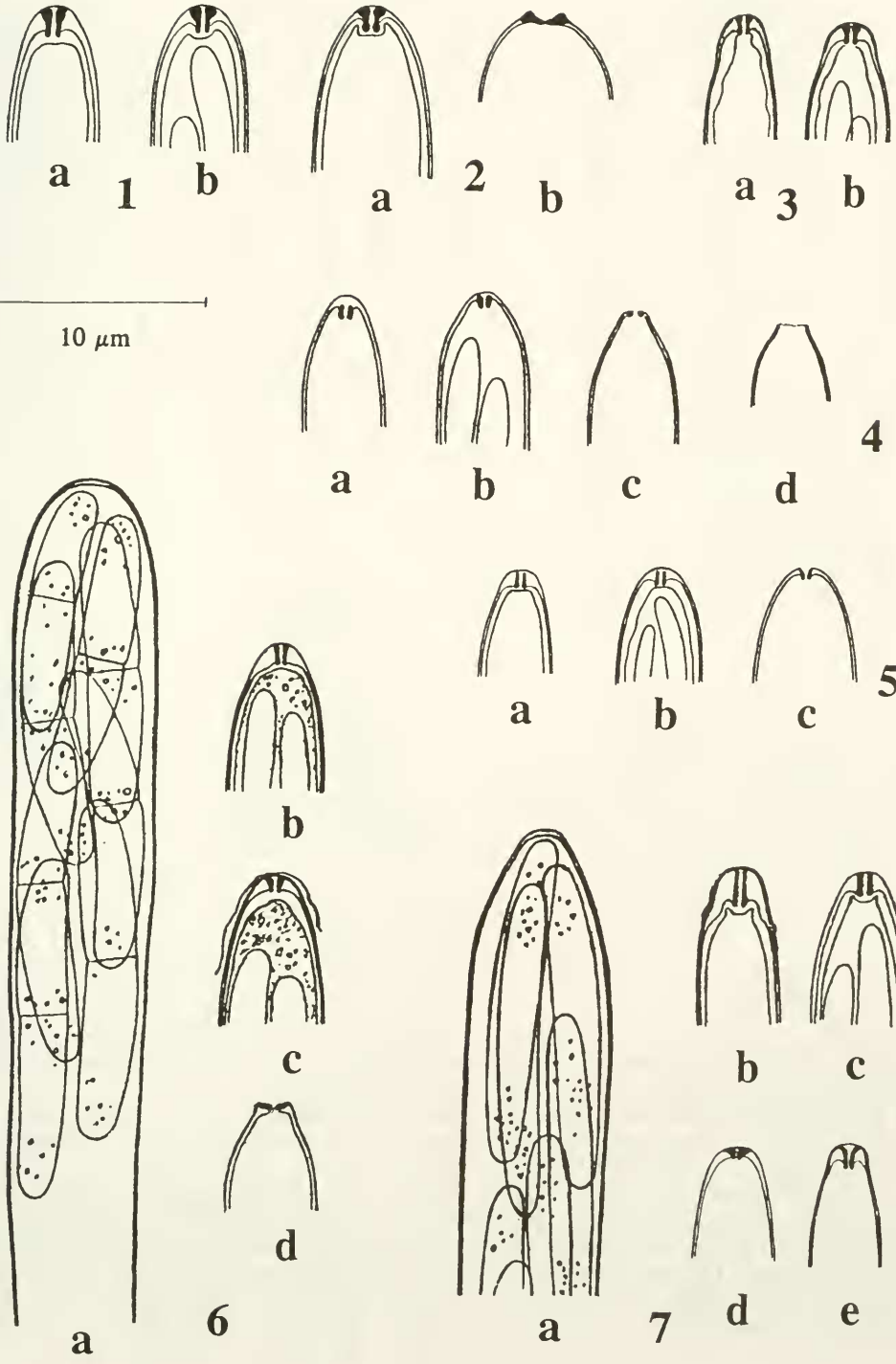
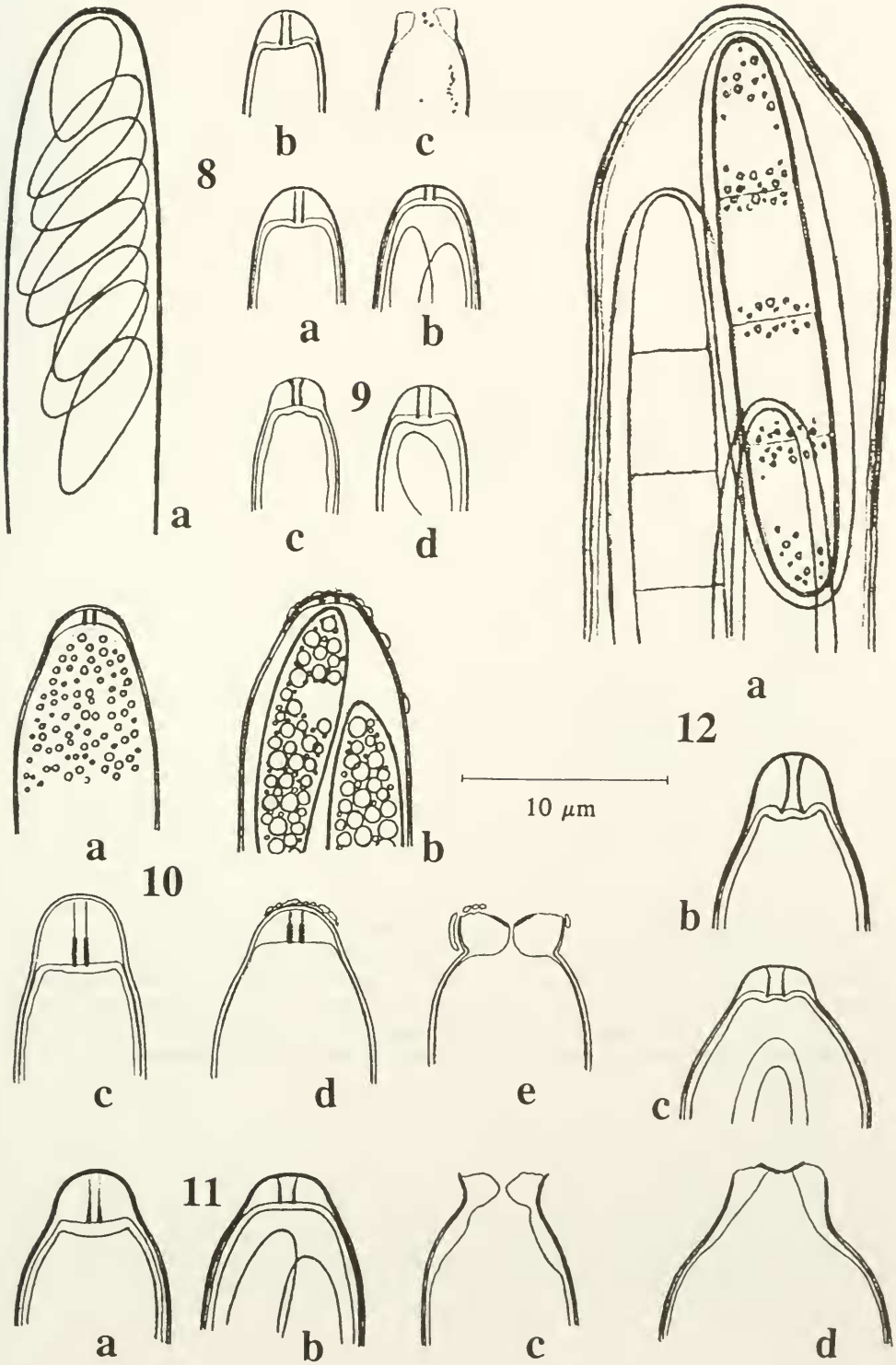

a
1
b
a
2
b
a
3
b
10 μm
a
b
c
d
4
a
b
c
5
a
6
b
c
d
a
7
b
c
d
e

Fig. 8–12. The ascus apices of selected taxa of the *C. coronatum*-group (drawn from dead asci, mounted in $I_{Lugol\ conc}$, if not otherwise indicated).
8. *Crocicreas calathicola* (*Rücker & Lohmeyer*; hb. BARAL 4243): mature, drawn from living asci, mounted in water (a), immature (b), dehisced (c). – 9. *Crocicreas calathicola* (*Collin*; hb. BARAL 4047): immature (a, c), mature (b, d). – 10. *Crocicreas coronatum* (*Baral*; hb. BARAL 3067): immature, drawn from living asci mounted in $I_{Lugol\ conc}$ (a), mature, drawn from living asci mounted in $I_{Lugol\ conc}$ (b), immature (c), mature (d), dehisced (e). – 11. *Crocicreas coronatum* (*Baral*; hb. BARAL 2942): immature (a), mature (b), dehisced (c). – 12. *Crocicreas culmicola* (*Baral*; hb. BARAL 2929): mature, drawn from living asci, mounted in water (a), immature (b), mature (c), dehisced (d).


8
a
b
c
a
b
9
c
d
12
a
b
c
10 μm
10
a
b
c
d
e
11
a
b
c
d

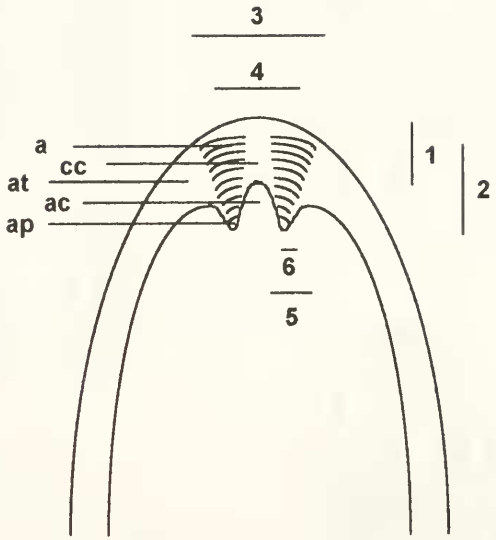


Fig. 13. Ascus apex components and measurements (terms and abbreviations according to BELLEMÈRE 1994: 116, fig. 2 and VERKLEY 1992: 5).
Annulus (= ring) (a); apical chamber (= ocular chamber) (ac); annular protrusion (forming a "pendatif") (ap); apical thickening (at); central cylinder (= axial mass) (cc). Tallness of the apical thickening (1); tallness of the annulus (2); maximal diameter (= maximal width) of the annulus (3); minimal diameter (= minimal width) of the annulus (4); maximal thickness of the annulus (5); minimal thickness of the annulus (6).